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ABSTRACT

Summaries of the objectives and types of science materials produced or planned for children (from 5-18) in English and Welsh schools are provided. There are twelve relatively large-scale science curriculum projects and seven (including some environmental, integrated, and general studies programs) that require some science. Each summary includes the address of the project director. Annotations on seven English research projects concerned with some aspect of science education, the address of two geography and four mathematics curriculum projects, and a select bibliography of Schools Council publications are also included. (AL)

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Schools Council

curriculum research and development in science

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Major large-scale curriculum studies in Science began in this country when the Nuffield Foundation financed the development of courses in Biology, Chemistry and Physics for the O-level of the General Certificate of Education and A-level in Biology, Chemistry, Physics and Physical Science.

Since 1963 development studies have expanded and have now been continued by further work financed by the Schools Council.

The age range covered by the projects is 5–18 and almost the whole ability range is catered for. This is particularly important in England and Wales at the present time since many schools are being organized on comprehensive lines. The reorganization of schools since 1965 has given rise to new kinds of establishments such as middle schools and sixth-form colleges.

The middle schools, most of which have an age range of 8–12 or 9–13, have given expression to the need felt by many teachers to bring fresh ideas to bear on the kinds of curriculum best suited to children aged 8–13 whose individual developments within a group of a given age may vary enormously.

The projects described in this paper range from those encouraging a wide-ranging, interest-centred, curriculum to those for older pupils with a clearly structured approach. Others are based more on topic work. Through all there is an emphasis on relevance of work to the pupils and a need to give pupils a 'hands-on' experience of genuine discovery.

The coherence of all this work lies in encouraging children to think; to look for patterns; to use these patterns to solve problems; to relate their knowledge of science and their scientific thinking to everyday experience.

This list also contains projects which cover the conceptual areas of several traditional subjects particularly in relation to a study of the environment, either looking for educational opportunities based on a study of the environment or devising studies leading to an understanding of man's place in the environment and his use of it.

Similar to these environmental studies are those relating to technology and creative design. Yet other projects in integrated or general studies require some knowledge of Science on the part of teachers who wish to use these materials.

The use of these project materials in schools is based on the decision of teachers in the local situation. A large number of groups, often in conjunction with the activities of teachers' centres, are continuing the process of curriculum design in their own schools.

A. RESEARCH AND DEVELOPMENT PROJECTS

Nuffield A-level Biological Science
The development stage is now complete. Materials for four units of work have been produced and evaluated. They are *Maintenance of the Organism, Organisms and Populations, The Developing Organism* and *Control and Co-ordination in Organisms.* In these, applied and pure biology are closely related and some topics of physical science and mathematics are introduced in a biological context. The scheme also includes project work, and complementary examination and assessment techniques have been devised.
Publication by Penguin Books from 1970. For students: 4 laboratory guides, 1 study guide, 13 topic reviews. For the teacher: 3 teacher's guides, 1 laboratory book, 1 project book. A number of film loops.
16–18 years 1965/70
P. J. Kelly, Centre for Science Education, Chelsea College of Science and Technology, Bridges Place, London, S.W.6.

Nuffield A-level Chemistry
This project has prepared a two-year scheme of work for A-level chemistry and has developed materials for pupils and teachers.
The course is modern in content, experimental in basis, and integrates as fully as possible the various aspects of the subject. It is based on 19 topics, to be followed by all students, together with one special study to be selected by each student from five possible alternatives.
Publication by Penguin Books from June 1970. For the student: two student's books, five special studies, experimental sheets, programmed texts. For the teacher: three teacher's guides, master diagrams for preparation of overhead projector transparencies, 8mm film loops and sheets of experimental instructions.
16–18 years 1965/69
E. H. Coulson, Centre for Science Education, Chelsea College of Science and Technology, Bridges Place, London, S.W.6.

Nuffield A-level Physical Science.
This project has developed an integrated A-level course in physical science in co-ordination with the Nuffield A-level physics and chemistry projects. Development work has included the devising of experiments and apparatus. An A-level pass is being accepted as an entry qualification in place of physics and/or chemistry by all university departments which normally require such passes.

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Publication by Penguin Books from 1972. For the student: workbook, sourcebook, introductory guide, book of data. For the teacher: two teacher's guides, overhead projection originals, film loops.
16–18 years 1965/69
Dr J. E. Spice, 12, Kingsgate Street, Winchester.

Nuffield A-level Physics
A project to construct a two-year course suitable for sixth-form pupils. The course attempts to emphasise the mutual relevance and interaction of different types of thinking in physics; the importance of thoughtful experimenting by pupils working both in groups and individually; and the relevance of the ideas and results of physics to society and to everyday life.
The Schools Council's support is for evaluation work.
Publication by Penguin Books from 1971. For the student: 8 guides. For the teacher: 8 guides, teacher's handbook, film loops.
16–18 years 1966/71
Dr P. J. Black and J. M. Ogborn, Chelsea College of Science and Technology, 90, Lillie Road, London, S.W.6.

Engineering Science
The Sixth-Form Engineering Science development unit at Loughborough, supported jointly by the University and the Council, has been set up following the successful development of an A-level syllabus and examination by the NUJMB.

The unit is to produce teachers' guidance material and pupils' texts together with resource material to aid the development of problem-centred teaching. The materials are intended to reflect the ways of thought and creative purpose of engineering by integrating its scientific bases with the essential social and economic factors which combine to form technology.
Teachers' guides, pupils' texts, resource material to be published in due course.
16–18 years 1970/73
Professor L. M. Cantor, Department of Education, Loughborough University, Loughborough, Leicester, LE11 3TU.

Project Technology
Project Technology aims to promote a full understanding by boys and girls in school of the importance and relevance of technology, and to develop their creative abilities through direct experience in technological activities. The project aims thereby to help pupils to understand the role of technology in society and the application of scientific knowledge to practical problems.

It is not intended to design a complete course in technology, but rather to develop teaching materials and to stimulate outside support of all kinds. These activities will help teachers to integrate technology with several subject areas of the school curriculum for pupils of all ability levels. This project has recently been granted a two-year extension from September 1970 to enable it to complete the trials of materials already produced, to extend the range of materials being provided, and to develop effective contacts with teacher training agencies. A periodical entitled *School Technology* is published five times a year and is available from the project.
Evaluation of the work is being carried out by D. A. Tawney and S. E. Gunn, under the direction of Professor S. J. Eggleston, at the University of Keele.
Publication from 1971 as follows:
Teachers' Guidance Booklets, project briefs – Heinemann Educational Books
Technology and Man (9–14) – Blackie and University of London Press
CSE Course material – English Universities Press
O-level History Units – Edward Arnold
A-level Course elements – University of London Press
Further details of all these are given in *The Next Two Years*, a progress report, 25p from the Schools Council.
11–18 years 1967/72
G. B. Harrison, College of Education, Loughborough.

Integrated Science
A project to develop a science course covering the normal range of science subjects of a sufficient standard to provide a satisfactory basis for all existing A-level science courses. The envisaged course will require six to seven teaching periods per week. The materials to be developed will be suitable for the O-level range of pupils, and will draw upon the experience gained in Nuffield science projects.
Publication by Longman and Penguin from 1973. There will probably be three pupil's manuals, three teacher's guides, a teacher's handbook, 30 background books and three technician's manuals.
13–16 years 1969/73
W. Hall and B. Mowl, Centre for Science Education Annexe, Chelsea College, 90, Lillie Road, London, S.W.6.

Nuffield Secondary Science
This project, supported by the Nuffield Foundation, has developed materials for an integrated Science Course for pupils aged 13–16 years who are unlikely to take the O-level examination in Science.

Financial support from the Schools Council is providing for evaluation work and a supplementary study to provide guidance to teachers on Mode III CSE examinations for pupils following courses using the materials developed by the project.
Publication by Longman from May 1971. A teacher's guide, 8 theme books, background readers and film loops.
13–16 years 1965/70
Mrs H. Misselbrook, Centre for Science Education, Chelsea College of Science and Technology, Bridges Place, London, S.W.6.

Nuffield Combined Science
This project has provided materials for a combined science course for pupils aged about 11 to 13, complete in itself and suitable as a lead into subsequent science courses including O-level courses (Nuffield or other), the Nuffield Secondary Science course, and CSE work.
Publication by Longman and Penguin Education from 1970. For the pupil: two activity packs. For the teacher: three teacher's guides, 19 film loops.
11–13 years 1965/69
M. J. Elwell, City of Birmingham College of Education, Westbourne Road, Birmingham, 15.

Science 5/13
The aim of this project, jointly sponsored by the Nuffield Foundation, the Scottish Education Department and the Schools Council, is to assist teachers to help children to gain experience and understanding of the environment, and to develop their powers of thinking effectively about it. This is being done through the identification and development of topics or areas of science related to a framework of concepts appropriate to the pupils' intellectual development. Evaluation has been a prominent feature of the development of this work.
Publication by Macdonald Educational from Spring 1972. 16 units for teachers.
5–13 years 1967/72
L. F. Ennever, University of Bristol, School of Education, 9 Tyndall Avenue, Bristol, BS8 1TQ.

Science and Mathematics in Welsh Medium Schools
The project is based on the assumption that work should start from children's own interests and should be pursued by actively investigating and enlarging on these interests. Account will be taken of problems of vocabulary, the linguistic facility of the children, and the provision of suitable reference books in Welsh.
Two teachers guides and 60 pupil's booklets are being prepared for publication.
5–12 years 1969/72
M. Griffiths, Faculty of Education, University College of Wales, Aberystwyth.

Educational Use of Living Organisms
Research to determine the needs of schools with respect to living organisms and the associated educational, administrative and biological problems; to identify and evaluate the usefulness of different species for teaching purposes; to devise suitable culture and maintenance techniques and appropriate teaching procedures for the effective use of the most appropriate species; and to provide information on these matters through the development of guidance pamphlets, charts and other visual material and help with relevant in-service training of teachers and laboratory assistants.

A series of booklets on aspects of the use of living organisms, wall charts, visual aids and a source book are being prepared.
5–18 years 1969/72
P. J. Kelly, Centre for Science Education, Chelsea College of Science and Technology, Bridges Place, London, S.W.6.

B. RESEARCH AND DEVELOPMENT PROJECTS CONTAINING ELEMENTS OF SCIENCE

Art and Craft Education
The aims of the project are to co-ordinate and make known advances in art and craft teaching; to consider the contribution which arts and crafts as an autonomous study can make to children's growth, and also their contribution to integrated studies; to undertake pilot experiments in the in-service education of teachers and to formulate principles on which future developments can be based.
A teacher's handbook, and discussion materials are in preparation.
8–13 years 1969/72
Miss Audrey Martin, Miss Seonaid Robertson, Michael Laxton, Goldsmiths' College, University of London, New Cross, London, S.E.14.

Design and Craft Education
The project, previously known as Handicraft Research and Development Project, is examining an approach to education in which pupils (particularly those who will be spending an extra year in full-time education) using tools and materials, are enabled to explore the adult world of our rapidly changing society. The major areas of development are *Materials Discovery and Design, Materials and Domestic Life, Materials and Community Life, Materials and Work, Materials and Leisure.*
Teacher and pupil materials in these five main areas will be published in due course.
13–16+ years 1968/73
Professor S. J. Eggleston, University of Keele, Department of Education, Keele, ST5 5BG.

Environmental Studies
The project is developing guides and other supporting material for teachers who wish to provide opportunities for children to investigate their physical and social environment. Publication by Rupert Hart-Davis from September 1971. Four teachers guides – a general introduction, a book of case-studies, *Starting from Rocks* and *Starting from Maps.* Three 16mm films are also being prepared.
5–13 years 1967/71
M. I. Harris, Cartrefle College of Education, Wrexham, Denbighshire.

General Studies
A project to help teachers improve the quality of general education in general or liberal studies and in 'specialist' courses taken by students aged 15 to 18 in secondary schools and colleges of further education. With the help of associated teachers, the project designs and tests units of study which embody a variety of ideas about learning, and which can be assembled in alternative patterns related to particular themes, topics or disciplines. The project also aims to devise appropriate methods for information storage and retrieval to support enquiry-based learning.
Publication by Penguin & Longman from late 1971, of units of loose-leaf resource material.
15–18 years 1968/72
R. Irvine Smith, University of York, The King's Manor, York, Y01 2EW.

Integrated Studies
A study to explore the possible means to and meaning of integration in the humanities. The central concern is with the organisation of learning most likely to lead to a relatedness of the disciplines through the concerted action of teams of teachers exploring themes, problems or areas of enquiry. The project is aimed at the whole ability range. Materials and teachers' handbooks have been prepared.
Publication by Oxford University Press from late 1971.
11–15 years 1968/72
D. W. Bolam, University of Keele, Institute of Education, Keele, ST5 5BG.

North-West Regional Curriculum Development Project
A project concerned with the production and co-ordination on a regional basis of a new curriculum for the last two years of secondary education for early-leaving pupils. The project's seven main study areas are creative arts, domestic studies, English, experimental teaching methods, moral education, social (including health) education and technology. Materials and papers will be published from 1972.
The Schools Council grant is for the support of the regional centre; the projects local development work – the major part of its activities – is financed entirely by the 13 LEAs involved.
13–16+ years 1967/72
Dr W. G. A. Rudd, School of Education, University of Manchester, Manchester, M13 9PL.

Project Environment
The project is attempting to build on the present tradition in schools of encouraging pupils to care for living things and to develop a sense of responsibility for them. It will aim to help teachers widen the work to involve studies of the school environment and to foster an interest in the quality of the environment and a concern for its intelligent management.
The team hopes to produce a variety of materials which would help teachers to build up a scheme of work suited to their own interests and to the school situation and circumstances, and possibly a 16mm film.
8–18 years 1970/73
R. W. Colton, Department of Education, University of Newcastle upon Tyne, St. Thomas' Street, Newcastle upon Tyne, NE1 7RU.

C. RESEARCH PROJECTS

Attitudes to Science Scales
To develop scales for measuring attitudes towards science and to relate scores on these scales to certain relevant variables such as CSE and GCE grades, sex of the pupil.
Attitude scales, answer key and manual are published by NFER, 1971.
14–16 years 1966/69
Dr L. Skurnik (formerly at the National Foundation for Education Research, The Mere, Upton Park, Slough, Bucks).

Evaluation of Science Teaching Methods in Secondary Schools
A study to classify teachers according to their preferred teaching style and to evaluate the effectiveness of each style by measuring pupils' scores on attainment and attitude tests. A research report will be prepared in due course.
14–16 years 1970/73
Professor J. F. Kerr and Mr J. F. Eggleston, School of Education, University of Leicester, 21, University Road, Leicester, LE1 7RF.

The Formation of Scientific Concepts
An investigation of scientific concepts developed by children taught by different methods. Methods of assessment will be developed and applied in schools using differing approaches to the teaching of science.
A research report is in preparation.
8–12 years 1968/72
Dr J. Rogers, University College of North Wales, Bangor, Caerns.

Investigation into the Operation of the Nuffield A-Level Chemistry Examination
The research is designed to monitor attainment of the objectives of the Nuffield A-level Chemistry course, to improve assessment techniques and to examine the way in which examination performance can be used to monitor curriculum design.
18 years 1970/73
J. C. Mathews, Department of Educational Research, University of Lancaster, Cartmel College, Bailrigg, Lancaster.

Measurement of Understanding of Pupils in Learning Science
To produce a set of test materials which can be used for comparing the outcome of different teaching methods in O-level Science courses.
Report and tests to be published 1972/73
14–16 years 1966/69
Professor F. W. Wagner, Institute of Education, The University, Southampton, SO9 5NH.

The Whole Curriculum for the Middle Years of Schooling
An investigation into the approaches to learning best suited to the needs of children in the middle years of schooling,

bearing in mind: the need to ease the transition from primary to secondary schooling; the opportunities provided by the newly established middle schools; the experience already gained with inter-disciplinary studies in junior and secondary schools; changing views about the content of the curriculum. The team hopes to produce an interim publication in 1971 and a curriculum bulletin in 1972.
8–13 years 1968/72
Professor A. Ross, Department of Educational Research, University of Lancaster, Cartmel College, Bailrigg, Lancaster.

Reduced Science Courses Suitable as a Preparation for Normal University Honours Courses in Science
An exercise in syllabus-matching between school and a technological university, including the study of sixth-form syllabuses and their suitability for courses at a technological university, with special reference to some of the unconventional courses offered at the University of Surrey.
16–18 years 1969/72
Professor L. R. B. Elton, Institute for Educational Technology, University of Surrey, Guildford, Surrey.

D. OTHER RELATED PROJECTS

Geography for the Young School Leaver
(14–16 years) 1970/73
R. A. Beddis and T. A. Dalton, Avery Hill College of Education, Avery Hill Road, London, S.E.9.

Geography 14–18
(14–18 years) 1970/74
Dr Gladys Hickman, University of Bristol School of Education, Helen Wodehouse Building, 35 Berkeley Square, Bristol, BS8 1JA.

Mathematics for the Majority
(13–16 years) 1967/72
P. Floyd, Institute of Education, University of Exeter, Gandy Street, Exeter, EX4 3QL.

Mathematics for the Majority—Continuation Project
(13–16 years) 1971/74
P. Kaner, Institute of Education, University of Exeter, Gandy Street, Exeter, EX4 3QL.

Midlands Maths Experiment
(11–18 years) 1968/71
C. Hope, Worcester College of Education, Henwick Grove, Worcs.

Sixth-Form Mathematics Curriculum Project
(16–18 years) 1969/75
C. P. Ormell, School of Education, University of Reading, Reading, Berks.

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'Art and Craft Education 8–13' *Dialogue* 5
'Design and Craft', *Dialogue* 8
Education through the Use of Materials; the possible role of school workshops in the education of secondary school pupils, (Working Paper 26): 1969 25p Evans/Methuen Educational.

Environmental Studies
'Teach-in at Abergavenny' (Environmental Studies Project), *Dialogue 1*
'The Alvecote Experiment', *Dialogue* 4.
'The Environmental Studies Approach', *Dialogue* 6.
'Think Conservation' Dr Colin Selby, *Dialogue* 6
'Enquiry Work in an Urban Setting', *Dialogue* 6.
Rural Studies in Secondary Schools, (Working Paper 24): 1969 20p Evans/Methuen Educational.

General Studies
General Studies 16–18, (Working Paper 25): 1969 16p Evans/Methuen Educational.

Integrated Studies
Integrated Studies in the First Years of Secondary School, (Pamphlet 19) free from Schools Council.

Mathematics
'Mathematics for the Majority', *Dialogue* 3.
Mathematics for the Majority: a programme in mathematics for the Young School Leaver (Working Paper 14): 1967 25p HMSO.

Middle Years of Schooling
'The Whole Curriculum for the Middle Years of Schooling', *Dialogue* 4.
The Middle Years of Schooling 8–13 (Working Paper 22): 1969 37½p HMSO.

N.W. Regional Curriculum Development Project
'Curriculum in the North West', *Dialogue* 7.

Science

Examinations Bulletins
8. *CSE experimental examinations: Science* 1965 15p (17½p) HMSO.
15. *Teachers' experience of school-based examining: English and Physics* 20p (24½p) 1967 HMSO.
19. *CSE: practical work in science* 1969 25p Evans/Methuen Educational.
21. *CSE: an experiment in the oral examining of chemistry* 1971 70p Evans/Methuen Educational.

Working Papers
1. *Science for the Young School Leaver* 1965 (free from Schools Council).
4. *Science in the Sixth Form* 1966 22½p (27p) HMSO.
38. *Support for school science and technology,* late 1971 Evans/Methuen Educational.

Field Reports
5. *Science in the Primary School* 1967 (free from Schools Council).

Curriculum Bulletins
2. *A school approach to technology* 1967 32½p (40p) HMSO.
3. *Changes in school science teaching* 1970 33p Evans/Methuen Educational.

Dialogue
1. 'Helping Children to Learn Science' (Science 5–13) L. F. Ennever.
1. 'Mind-making or Machine-making' (Project Technology).
4. Nuffield & Schools Council – Combined Science 11–13 and Integrated Science 13–15 Projects.
6. 'Early Experiences' (Science 5–13).
7. 'Keeping Things Alive' (EULO Project) John Wray.
8. 'Science Teaching Changes' Peter Scott.

Publications of the S.C. Committee for Wales
Science Bulletin No. 1 (October 1968).
Science Bulletin No. 2 (September 1969).
Science Bulletin No. 3 (March 1970).
Science Bulletin No. 4 (September 1970).
Science Bulletin No. 5 (March 1971).
Most articles in these bulletins are in English; some are in Welsh.

Notes
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